ADLER (A.S.)

A Contribution to the doctrine of bilateral functions

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With the compliments of the author

A CONTRIBUTION TO THE

Doctrine of Bilateral Junctions,

AFTER EXPERIENCES OF METALOSCOPY.

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I. METALOSCOPICAL.

Burq appeared in the year 1848, with the assertion that he was able to cure hemianesthesia of hysterical women by the application of metallic discs; that the patients presented different idiosyncrasies for metals; some became sensitive again after the use of gold, some by copper, zinc, etc.; also that the metals had the same effect when taken internally. Therefore metalo-therapeutics is divided into an external and internal use.

Burq used in 1849, copper in the treatment of cholera in the *Hôpital Cochin.*[1] His first publication appeared in the year 1851;[2] he published further his "*memoirs sur quelques accidents nerveux consecutifs au Choléra et leur traitement par les armaturs metalliques,*"[3] in 1852. Again, different cases of chlorosis appeared which he had cured by iron.[4] He published in 1853, "*traité de métallothérapie.*"

Bozias, physician to the *hôtel Dieu*, described in 1860, *cas très-curieux d'hysterie et de chlorose, gueri par la métallothérapie,*[5]

1 *Gaz. méd de Paris*, 1850, Feb. 22.

2 *Burq, Nouvelle doctrine et nouveau traitement des maladies nerveuses. Thèse de Paris*, 1851.

3 *Burq. Choléra. De l'immunité acquise par les ouvriers en cuivre et observat et expérience depuis*, 1849, 1867.

4 *Gaz. méd. de Paris*, 1852, June. 5 *Gaz. de Hôpit.*, 1860, May 22, p. 237.

and at the same time remarkable phenomena. Patients were said to have had first a sensation of itching, followed by the return of the sensibility and muscular power. The sensation was always beneath the metal itself. On the same occasion he observed heat and perspiration on the skin.

On the 19th of June, 1860, BURQ communicated to the *Academie Impériale de Médecine* on chlorosis, and the manner and means to cure it with iron;[1] as in one case of nervous paralysis with chlorosis, iron failed to succeed; he treated the case externally and internally with copper and zinc—*sur les indications de la métallothérapie.*[2] Furthermore, he speaks of the order and course of the symptoms which iron had produced in the treatment of chlorosis.[3]

From this time till 1867 no further publication of this new and marvelous doctrine appeared.

In 1867 BURQ published further experiences how copper acted in the treatment of cholera, which he used at first in 1849.[4] With the aid of VERNEUIL, HERARD,[5] BOUCHER and DUMONTPALLIER, he experimented in the *Hôpital de Lariboisière* to cure different cases, as[6] (1) dysmenorrhea, then amenorrhea, with anorexia, headache, palpitation, neuralgia, and accompanied by general anesthesia; (2) irregular menstruation, leucorrhea, anesthesia of right arm, of left leg, absence of taste and weakened smell; (3) irregularity of menstruation, frequent micturation and palpitation, headache, pain in the stomach, anesthesia, etc.

He then treated diabetes with Vichy water and metals.[7] In 1877. finally the experiments, which were made first in the Hospital Lariboisière, were transferred later to the Salpetrière, where CHARCOT himself repeated them. The results, which he communicated to the Societe de Bologie, coincide with those of BURQ, viz., if he applied metals upon any part of the hemianesthetic side of the patient, the sensibility would return in the course of ten to twenty minutes. The sensibility is returned in a zone of 5 to 6 centimetres, above and below the point of application. The

1 *Gaz. de Hopit*, 1860, p. 291.

2 *Ibid.*, p. 342.

3 *Gaz. de Hopit*, 1860, p. 402.

4 *Cholera de l'immuieté et Paris*, 1867; *Gazette des Hôpitaux*, 1869, p. 249

5 *Gazette Méd. de Paris*, 1877, pp. 381, 429, 452, 476.

6 *Gazette des Hôpit.*. 1869, pp. 237, 249.

7 "BURQ, applicat des metaux aux eaux de Vichy. Traitement du diabet par les metaux associés aux eaux de Vichy, 1871."

sensibility is only temporarily present, and lasts usually from a few hours to a whole day.[1]

The special senses, as smell, taste and hearing, are influenced in the same manner.[2] He is said to have cured two cases of hemichorea and hemianesthesia, which originated from an old injury, by the application of metals. Further, he says, that by the aid of these the sensibility lasts longer than by the hysterical.[3] CHARCOT explains, in a lecture held at the Salpetriere, the following: "If, after the return of the sensibility, the metals are longer applied, then the anesthesia would return in a higher degree than it existed before the application of metals. BURQ terms this "l'anesthesie de retour." At that time, CHARCOT showed in his lectures cases of amblyopia, which exist on the same side where the anesthesia exists. One of the characteristics of this amblyopia is achromatopsia, or a loss of the field of vision in regard to colors. Colors are lost in a "mathematical order:" first violet, green, red, and lastly blue. If he applied gold upon the temporal region, then the patients would perceive colors: first, blue, then red, green and violet, exactly in the reversed order to that in which the colors had been lost.

Now gold was applied upon a hysterical woman, who was sensitive to gold, to see if she was completely cured. The result obtained was that the patient complained at first of a certain inconveniency. She became then drowsy, and readily slept, and the return of the anesthesia could be demonstrated; a proof that she was not completely cured.[4] He then treated his patients with a solution of chloride of sodium and gold (0.01 to 25 gtt. per dose) internally; after which the sensibility returned. If he applied gold then the metalic anesthesia would appear.

Before the publication of these last mentioned facts, at BURQ's request, a commission, consisting of CHARCOT, LUYS and DUMONTPALLIER, assisted by GELLE, LANDOLT and REGNARD, was appointed by the Societe de Biologie to investigate his doctrine. This commission confirmed exactly what BURQ had found, and reported that ten minutes after the use of the metals the patients complained of a sensation of warmth and numbness in the region of the metalic discs. The part upon which the metal lay became red; now a prick becomes painful at the place of the application of

1 *Gaz. de Med.*, de Paris, 1877, p. 59. *Progres Med.*, 1877, p, 48.
2 Ibid, pp, 60, 87.
3 *London Lancet*, 1878, vol. ii, p. 81, 158, 302.
4 *London Lancet*, 1878, *vol. ii, pp.* 81, 158, 302.

the metals, and the zone extends more or less above and below the point of application. In a certain distance of the disc the phenomena of disesthesia (incomplete return of the sensibility) could be noticed. The temperature of the affected side was always higher than that of the normal. If you pricked the patient now she would bleed, which did not occur before the metals were applied; also it was found that sight and hearing became more acute after the application of the metal upon the forehead, temporal region and mastoid process. The same phenomena presented itself after the use of the metal upon one-half of the tongue, one side of the nose, their function is returned by them. They found also an interesting physiological fact, which they called *transfert de la sensibilité*. As soon as the sensibility had returned upon the anesthetic side, the sensibility of the healthy side would diminish upon a symmetrically-situated point, and would return as soon as the anesthesia returns to the sick side.[1]

A second report of the commission confirms further what I have already described by CHARCOT in regard to the internal use of metals. In short, it treats of the confirmation of facts that those metals which are effective if used externally, act the same if taken internally, and confirm the same.[2] Used internally, the sensibility was seen to exist as long as it was used, and by means of which the anesthesia, muscular weakness and the irregular menses were removed, the hysterical convulsions, leucorrhea, and the whole physical deportment of the patient were modified.

After the just-related very remarkable facts of the French physicians were established, they made it a task to examine the cause of this peculiar effect of the application of metals.

REGNARD[3] believes that electricity is the cause, and therefore performs the following examples and experiments. He asks himself three questions, which he undertakes to solve:

(1.) "Are currents developed at the place of application, and how great is their intensity?"

(2.) "Is it possible to produce the action of the metallic discs with currents which are equal to those produced by the metals, and originate from any source?"

(3.) "What is it that produces the cause of selection which some patients have to certain metals.?"

To answer these three questions he applied a metallic disc upon

1 *Gazette Med.*, 1871, p. 201. *Le Progres Med.*, 1827, p. 309.

2 *Gazette Med.*, 1878, Nos. 35 to 37.

3 *Progres Med.*, 1877, p. 150. *Gaz. Med.*, 1877, p. 125.

the anesthetic skin of the patient, and a platinum-electrode on any other part of the body. By means of which a current is produced which goes from the disc to the electrode. Intensity depends essentially upon the changeability of the metals and the distance of the electrodes. An integument covered with perspiration also increases the intensity of the current. A piece of coin-gold gave a current of about 2°–5° inclination of a fine-thread galvanometer of 30,000 circuits. A copper-disc gave no more thon 2° inclination; a disc covered with gold by galvanizing, and a platinum disc, only a slight movement of the needle.

To solve the second question it was possible to reproduce all the phenomena which the metallic discs showed, by means of a Trouve's pile graduated by a rheostat connected to the patient and to a galvanometer. The time required to produce it was always fifteen minutes.

In one patient a current of 40° was inactive; one of 50° active. He found that weaker currents suffice to reproduce the sensibility, whilst stronger did not excite the least action.

In the case of B——, who was sensitive tc copper, currents of 5°, 10° and 15° were without effect, while with a current of 45° it was possible to return the sensibility in fifteen minutes. A current of 70° was inactive, but one of 90° returned the sensibility.

In the case of G——, who became sensitive by gold, a current of 10° returned the sensibility; a current of 40° was inactive, whilst one of 90 was very active.

"There exist thus in the galvanometric scale"—this fact was formulated by its discoverer, Regnard—"certain identical points each time for the same patient, where, under the influence of the current, the sensibility returns, whilst this is not the case if the current become either stronger or weaker, no matter how long it was applied." These points Regnard called neutral points.[1]

Eulenburg[2] used unpolarized (Du Bois-Reymond) electrode to repeat these experiments, in order to exclude the influence of polarization. He found that if a copper disc, two and a half centimeters long and one and a half centimeters broad, was applied upon the skin, and he then closed with the inserted closer, the needle would incline first to the right, standing at 10°, then slowly returning to 5°. If he opened now till the needle stood

1 *Berliner Klin. Wochenschrift*, 1878, p. 129.

2 *Eulenburg, Deutsche Med. Wochenschrift*, 1878, No. 25; *Lehrbuch der Nervenkrankh.*, 1878, p 718.

at 0°, and after he had placed the copper disc beneath the electrode which was connected with the skin, then closed, the needle would incline to the left side at the same degrees. The results with zinc were the opposite; the needle would first incline to the left, standing at 20°, to return to 8°. If the skin is moistened by an electolyte (salt) the same is highly increased.

Onimus [1] refers the effect to the electro-capillary currents, whilst Rabuteau [2] contradicts this and puts it to the chemical action produced by the contact of the metal with the moist surface.

Magnan[3] read to the *Societé de Biologie* the effect of continuous currents in cases of hemianesthesia of cerebral origin (two hysterical women and two male alcoholics). He found that on the first day thirty elements of a Trouve's pile were sufficient to return the sensibility. The next day eight, and on the next following day fifteen elements were sufficient. No transfer could be demonstrated.

Vigoroux sets up a physical theory of the metalo-therapy, to prove that the following is the real cause of the action of the electricity. He applies gold upon a patient who became sensible by gold, and upon it a piece of silver, thereby causing the cessation of the action of the gold. The sensibility would only then return if either the piece of silver is removed or a second piece of gold placed on it, so that the silver occupies the center. He says that according to Volta, a disc consisting of zinc and copper, which are placed upon another, produce different electricity, which can exactly be determined by the electroscope. The contact alone, not the chemical action, had produced this! This would be confirmed by the law of tension, which declares that the difference of electrical currents which the two metals produce by their contact is the same as if they were directly connected. This ceases as soon as the external discs are of the same metal. He deducts from this the contact of the integument and gold, by means of which an electrical current is produced, and soon as silver is applied, then after the laws of tension the silver and skin were in direct communication, and therefore the silver had no effect upon the patient. If, again, gold is applied upon it, then gold is again in direct connection with the skin; therefore the return of the sensibility could be obtained. It would be difficult

1 *Gaz. Méd.*, 1877, pp. 60, 73.
2 *Ibid.*, p. 74.
3 *Gaz. des Hóp.*, pp. 77, 374.

to understand, if a chemical action (oxydation, etc.) is the cause of the presence of the electrical current, how the application of another metal removes its effect. Furthermore, he experiments with statistic electricity and unpolarized electrodes to return the sensibility.

Charcot,[1] in a further communication, reports to the *Societe de Biologie* that he had undertaken further experiments, and found that a large horse-shoe magnet had the same effect as weak electrical currents; *id est*, to promote the return of the sensibility. Westphal[2] was able to confirm this. Ad. Meyer[3] tells us of an interesting case of a limited anesthesia in the region of the ramus perforans lateralis nervi dorsalis VIII, which was said to have remained after a herpes zoster. A silver disc (two-mark piece) was applied, and after a duration of five minutes the patient complained of tickling and itching in the left scapular region; further over a sense of warmth and shivering in the shoulder region, over the left side, to the upper thigh, and he believed that somebody had applied leeches. Anesthesia disappeared in the course of ten minutes.

II. BILATERAL FUNCTION. *(Adamkiewicz.)*

After it had seemed that the fact was established in this manner, as well as by experiments performed in Germany and in France, that electrical currents could be demonstrated at the point of the application of the metals, the opinion seemed to be justified that the effect of the metals on the sensibility must be referred to their power to produce such currents. But the circumstance that in the report of the French it is spoken constantly of hyperemia and light inclination to hemorrhage, induced Adamkiewicz to examine whether the action of the metal did not depend upon their power to *irritate mechanically*. To examine this he was the more compelled because the *transfert de la sensibilite* described by the French seemed to him to be a phenomena which seemed to belong in the category of the bilateral symmetrical function found by him in the secretion of perspiration. To confirm his supposition of the action of the metal, he used simple irritation in the form of a mustard plaster, and he, as well as Westphal, could report that they had observed a restitution of the sensibility at the point of application, and also the occurrence of the *transfert*. The restituted sensibility partly disappeared.

1 *Le Progrès Méd.*, 1878, *pp.* 353, 573.
2 *Berl. Klin. Wochenschrift*, 1878, p. 440.
3 Ibid., p. 496,

partly remained. At this occasion an experiment performed by Westphal was remarkable, in which a mustard plaster was applied on two symmetrically-situated parts of the arm, resulting that the sensibility returned on one side beneath the mustard, and not upon the other, which is again a new confirmation of the dependency of bilateral symmetrical points in regard to their sensible functions. Adamkiewicz therefore proved the action of a simple irritation in sensibility—restitution, as he calls it—and the analogous action of such an irritation with the metaloscopy described by the French.

Soon other authors used different irritations to produce metaloscopical phenomena. Westphal saw the sensibility return after the application of *Spielmarken* upon anesthetic parts, after they had been fastened tight with great exertion. Other authors have done in similar manner. Hughes Bennet also used wooden discs. In newest times Ingles had repeated the experiments of Adamkiewicz with the same effect. In a case of anesthesia where he had used mustard, he obtained the return of the sensibility in a few hours. The *transfert* lasted only a few hours, and the healthy arm nearly became quite anesthetic.

After I have placed together all experience of the present time in regard to the peculiar phenomena in cases of hemianesthesia, I turn to the question, what is the cause of the described phenomena? In general one is inclined to place little value upon experience gained in hysterical persons, in the supposition that very much is either simulated or psychologically influenced in these persons who usually are very markedly altered psychologically. Although in general the fact has been established that hysterical persons are subject in a high degree to irresponsible psychological impressions, the names of the above mentioned authors warrant that they at their examination have guarded against fraud. Therefore a simple psychological impression of the patient cannot be accepted as an explanation; and for us the question remains if it depends in fact upon a peculiar unknown action of the metals upon the sensibility (Charcot and the other French physicians) or upon electrical action of the same (Regnard, Eulenburg, etc.) or simply upon a simple irritation (Adamkiewicz). Vierordt[1] has made a trial to decide this. He mechanically irritated decapitated frogs, and compared the number of the reflex action following it in two cases with another, where at one time metals (zinc) had been applied upon the

1 *Centralblatt del Med. Wiss.*, 1879, No. 1.

abdomen of the animal and the other time nothing. To conclude from his tables, as much as can be understood from the indistinct presentation of the author, it seems that the time of the reflex actions decreases after the application of the metals. Taken into consideration that in these experiments the reflex cannot directly be used as a measure to judge the influence of the employed metal upon the sensibility, it must still be remembered that the effect of the same in these experiments might have been induced possibly by the incompleteness of the applied irritation, as simple pressure of the forceps was used, and therefore no care was taken for the equality of the same.

I was instructed to discover if the sensibility increases or decreases after the application of the metals, and if the influence of the metals upon the sensibility equals or not that of a simple irritation; in which experiment I used mustard, after the procedure of Adamkiewicz. Two hysterical women of the Westphal's Nervenklinick were placed at my disposition. I applied upon a determined place different kinds of metallic discs, and then mustard plasters. The discs which I employed at my experiments were those made by Burq. They were of the size of a half dollar, and fastened to the part of the body by means of a ribbon. To have a reliable measure of the sensibility, I used the Eulenburg esthesiometer, and found the distance of the two points which the patient declared to have felt as one point. After the normal was found, I applied metal or mustard, and examined if the distance increased or decreased. In the description I term it esthesiometrical, measured, and in centimeters.

FIRST CASE OF HEMIANESTHESIA.

Mrs. Fensch suffers with hemianesthesia of the body and of the whole face and paraplegia of the feet. The sensibility of the right leg has completely disappeared. Above, this anesthesia extends over the whole right half of the body, including the face and over the right half of the back. The left side of the back, as well as the left half of the scalp, show again sensibility to pricks of a pin. Also the left half of the thorax, arm and leg have a sensibility, but highly decreased. But the left half of the face and the right side are completely anesthetic.

Sunday morning, 9½ o'clock. Copper discs are applied upon the anesthetic forearm. The æsthesiometrical measure was upon H. (healthy side), 4, 2 ctm., and upon A. (affected side), the pressure of the compass could not be felt at all. The measure

of the healthy side in each instance was taken on a place situated symmetrically to the affected. After a lapse of seven hours the sensibility had not returned. Only pricks of a pin were very weakly perceived beneath the metals themselves. Fifteen hours later pricks were felt below the place of the application, extending to the tips of the fingers. Now the esthesiometrical measure amounted to A. 2, 4, H., 7 ctm.

Next morning (Monday), fourteen hours later (thirty-six hours after the time of application), no change could be noticed in the sensibility. The esthesiometric measure 17 ctm. below the place of application is A. 2, 2 H., 2, 9. Five hours later the sensibility was still present below the place of application, and the metal is removed three hours later.

Tuesday morning, 10 o'clock, iron is fastened 21 ctm. above the place where the copper had been applied; and after it had remained twenty-four hours without any effect it is again removed.

Wednesday morning, zinc is substituted. After a duration of twenty-four hours (Thursday), whilst I was absent, the complete return of the sensibility was found. I examined her six hours later, but could not detect the return of the sensibility, only below the place where five days ago the copper had been applied. Zinc is now removed and tin applied, which laid thirty-six hours without any effect (Friday).

Sunday morning, 7 o'clock. Mustard plaster is applied upon the center of the anesthetic thigh. Esthesiometric measure was, A., nothing felt; H., more than 12 ctm. After it had been applied for about half-an-hour, the patient felt a prick beneath the mustard and in the knee-joint, followed by itching and such vehement pains that it became necessary to remove the mustard at nine o'clock (two hours later). The place of the application was red, hyperemic and excessively sensitive to the slightest touch, so that the patient cryingly begs the physician not to touch her. She was unable to bear it on account of the pain which the touch was causing. The returned sensibility extended in the length of 21 ctm., 15 above and 6 below the upper border of the patella, and in the circumference of the leg in the above named length. After eleven and a half hours had passed the redness had disappeared, but the sensibility existed still in the same degree. On questioning the patient, in regard to psychological influence, she answers that she had neither fright, fear or excitement, and in the rest did not trouble herself at all

what was done to her. Six hours later esthesecometric measure was A. 4, 9, H. 6, 3. At my visit (Monday, 10½ A. M.), the sensibility was found still in the extension of 21 ctm., 5 above and 16 ctm. below the upper border of the patella.

Esthesecometric measure: A., 4, 9; H., 6, 3. Sensibility of the hand and forearm still exist.

Tuesday morning, ten o'clock, the extension of the sensibility of the upper thigh is 16 ctm., 6 above and 10 below the upper border of the patella. Esthesecometric measure is A., 6, 2; H., 6, 2. At eleven o'clock copper is applied upon the same place of the arm where last week the before-mentioned metals proved ineffective. The esthesecometric examination results that no pricks are perceived on A.; at H. more than 12 ctm. the two points are felt as one. At half-past four of the same day no change had occurred in the sensibility of the thigh. Upper arm is only sensitive to the prick of a pin beneath the three inside metals. At seven o'clock patient feels pain in the elbow-joint and in the whole surface of the arm, that her whole hand pained. I found at the examination that she reacts upon pricks of a pin only to a limited extent—that the return of the sensibility was only partial. The same extended below the three inside metals, beneath which, three hours ago, sensibility was felt in the length of 16 ctm. and in the breadth of 4 to 5 ctm. Esthesecometric measure was A., 5, 8; H., 7, 3. Sensibility has decreased 6 ctm. upon the fore-arm; leg, no change.

Wednesday, ten A. M., the sensibility of the thigh has decreased 4 ctm; the sensibility of the upper arm same as yesterday. Esthesecometric measure: A., 8, 0; H., 5, 0. At the place of application the measurement was A., 3, 6; H., 7, 3; fore-arm, A., 1, 6; H., 1, 6.

Mustard plaster is applied to the leg. Esthesecometric measure: A., no sensation; H., 6, 5. After a lapse of four hours patient complains of vehement pains; hyperesthesia in the highest degree present. A., 5, 2; H., 6, 5.

Thursday—Esthesecometric measure, half-past nine A. M.: A., 6, 6; H., 6, 7; eleven A. M.: A, 5, 2; H., 6, 0; half-past four P. M: A., 7, 0; H., 6, 3.

Friday, ten A. M.: A., 5, 8; H., 6, 6.

Sensibility of thigh has decreased 2 ctm. As patient complains of too severe pains, cold applications are prescribed, and further examinations desisted from, as we had obtained our object.

ANOTHER CASE OF HEMIANESTHESIA.

Mrs. Schlender, forty-seven years old, suffers from a left-sided hemianesthesia. Face presents an abnormal decrease of sensibility; the deepest pricks of a pin upon the right side produce a very deficient sensation; on the left they are not felt at all; also a power of sensation to pricks of a pin are noticed upon the haired head, where the left side is absolutely anesthetic, whilst the right side gives a weak perception of the sensibility to the pricks of a needle. The same can be said of the mucous membrane of the nose, where, on the right side there is a slight sensibility left; the left side, none. Assafetida is not smelt at all at the left side. By brushing the right half of the tongue, she tastes the fluid a little; left, not. Pricks of the needle are felt on the right upper thigh, yet not with normal acuteness. The whole extent of the left arm can be pricked deep with pins without patient reacting. Same can be remarked on the left leg. On the right side the patient reacts with reflex action of perception; left, not. She is sensible to pricks only in the regio papilla mammalis sinistra. I applied a mustard plaster upon the upper part of the anesthetic thigh. The esthesiometric measure was: A., no perception; H., 0, 4 ctm. After the mustard had been applied for nearly four hours, pricks of the pin are felt not only upon the healthy, but also upon the side which prior had been anesthetic. The esthesiometric measure was A., 2, 8; H., 6, 6. Two hours later I found that what she perceived as two points upon the affected side she felt as *one* upon the healthy.

Five and a half hours later, esthesiometric measure was A., 5, 8; H., 6, 6; three hours later: A., 6, 4; H., 7, 2; next morning at half past nine o'clock: A., 2, 1; H., 3, 9.

The result of this examination shows that in hemianesthetic persons the simple irritation of the mustard plaster increases the decreased perception of the affected side and decreases the normal perception of the healthy side in a similar relation. Metals operate the same.

After I had established in this manner that a difference, determined by the esthesiometer, had appeared in regard to the change of the sensibility, I was requested to examine how it stood with normal males. I selected therefore men free from all disturbance of the sensibility, and in each applied metal discs and mustard plasters, as mentioned above for the females, one hand-breath above the wrist-joint. The experiment resulted thus:

H. EXPERIMENTS WITH METALS.

1. HERR VON LICHTENBERG.

Minutes.	Copper.	Gold.	Zinc.	Tin.	Iron.
0	2.0	2.2	2.0	2.9	1.1
5	2.0	1.8	2.0	2.9	1.9
10	2.5	1.8	2.0	2.9	1.2
15	2.1	1.0	2.0	2.3	1.2
20	1.8	1.0	2.0	2.7	2.1
25	1.3	1.0	2.0	2.2	2.0
30	1.3	1.0	2.0	2.6	2.2
35	1.2	0.4	2.0	2.6	2.2
40	1.8	0.2	2.0	2.6	2.0
45	1.5	0.2	2.0	2.6	2.0
50	1.5	0.2	2.0	2.6	2.0
55	1.5	0.2	2.0	2.6	2.0
60	1.5	0.2	2.0	2.6	2.0
At the place of application	2.9	1.5	...	2.6	...
8 hours later	..	..	2.0	...	2.0

It will be seen from the above table that I examined the sensibility every five minutes for a whole hour, and that the result obtained is very different in many metals. The number of centimeters indicate the distance of the two points of the esthesiometer which the person felt as one point. The examination was always made below the place of application after sixty minutes. The cause of the difference of the esthesiometric measure can, perhaps, be found in the repeated manipulation in such a short time, although in some of them determined diminution of the esthesiometric distance can be ascertained; in other words, an increase of the sensibility. Copper, in the commencement of the of the experiment, was 2.0 centimeters distance, which I had determined as normal after one half hour's treatment. After sixty minutes it is 1.5. During this time it presents 1.3 centimeters distance. Of gold, in the commencement, 2.2 centimeters distance; after a lapse of sixty minutes 0 2. This gives us a considerable diminution of the esthesiometer measurement; therefore an increase of the sensibility. Of zinc, in the commencement the esthesiometic measure is 2.0: the same after sixty minutes; later even shows no change. Whilst tin showed in the start 2.9, then 2.2, then fluctuating between 2.3 and 2.2—shows for thirty-five minutes 2.6—therefore a change of the esthesiometric distances of 0.3 centimeters. Nothing certain can be determined of iron, as the distance changes so frequent.

To resume, we have obtained an increase of the sensibility with copper, gold and tin; no change with zinc, and uncertain with iron.

2. HERR LUECKE.

Minutes.	Copper.	Gold.	Zinc.	Tin.	Iron.
0	2.9	2.3	2.6	2.0	2.8
5	2.9	2.7	2.6	2.2	2.8
10	2.8	2.3	2.6	3.1	2.8
15	2.8	2.6	2.6	3.1	2.8
20	2.8	2.8	2.6	3.1	2.8
25	2.8	2.8	2.5	3.1	2.8
30	2.6	2.8	2.5	3.1	2.8
35	2.6	2.8	2.5	3.1	2.8
40	2.6	2.8	2.5	3.1	2.8
45	2.6	2.8	2.5	3.1	2.8
50	2.2	2.8	2.5	3.1	2.8
55	2.2	2.8	2.0	3.1	2.4
60	2.6	2.8	2.0	3.1	2.4
At place of application	...	3.2	...	...	2.8
8 hours later	2.2	...	...	3.1	

A diminution of the distance measured by the esthesiometer of 0.7 centimeters has appeared with copper after eight hours application, after sixty minutes of 0.3. Gold shows an increase of the esthesiometric distance of 0.5 centimeters. Zinc again presents a dimution of 0.6 centimeters; at tin an increase of 1.1 centimeters is found; and iron has a decrease of 0.4.

3. HERR KRAUSE.

Minutes.	Copper.	Tin.
0	2 0	1.2
5	2.0	2.1
10	1.5	2.1
15	1.5	2.1
20	2.0	2.0
25	2.0	2.0
30	2.0	2.0
35	2.0	1.5
40	2.0	1.5
45	2.0	1.5
50	2.0	1.5
55	2.0	1.5
60	2.0	..
Place of application	...	...
8 hours later	2 0	1.2

4. HERR HEISE.

Iron.	Gold.	Zinc.
1.6	1.6	2.6
1.6	1.6	1.7
1.6	1.6	1.7
1.6	1.6	1.3
1.6	1.6	1.6
1.6	1.6	1.6
1.6	1.6	1.5
1.6	1.6	1.3
1.6	1.6	1.3
1.6	1.6	1.3
1.6	1.6	1.3
1.6	1.7	1.3
1.6	1.6	1.3
1.6	2.0	2.0
...	...	

No certain change can be noticed in Krause after the use of copper or tin, although the distances with tin differ. In Heise neither with gold nor with iron can a change be noted. Again with zinc the distance has decreased about 1.3 centimeters, an excessive increase of the sensibility.

5. HERR RIETDORF.

Minutes.	Copper.	Zinc.	Tin.	Iron.	Minutes.	Gold.
0	8	1.4	1.7	1.7	0	1.0
5	1.8	1.2	1.6	1.7	5	1.0
10	1.8	2.0	1.6	1.7	10	0.4
15	1.8	2.0	1.6	1.7	15	0.8
20	1.8	1.8	1.6	1.7	60	1.2
25	1.8	1.9	1.4	1.7	120	1.2
30	1.8	0.7	1.4	1.7	180	1.2
35	1.6	0.2	1.4	1.7	Place of application	1.2
40	1.4	0.2	1.6	1.7		
45	1.4	0.2	1.5	1.7		
50	1.4	0.2	1.5	1.7		
55	1.4	0.2	1.6	1.7		
60	1.4	0.2	1.6	1.7		
8 hours later	...	1.0	...	1.7		
Place of appplication	1.4	...	2.2	...		

An increase of the sensibility with copper and zinc, no change with iron, uncertain with gold and tin.

B. EXPERIMENTS WITH MUSTARD PLASTER.

NAME.	Left.		Right.	
	Before the application.	After application.	Before the application.	After application.
Heise	5.5	4.9	7.4	8.7
Lichtenberg	2.8	1.7	4.9	5.7
Rietdorf	3.4	2.6	2.9	3.7
Luecke	6.2	4.3	5.4	6.8

The mustard plaster in every instance was applied for one and one-half hours upon the same part of the left forearm upon which the metallic discs had been applied. The result can be clearly seen as above. To prove the experiment upon my own person I applied a large plaster upon my left forearm. Esthesiometric measurement (measured by Adamkiewicz) was 5.5 centimeters. No change could be observed after one hour had elapsed. I could bear it only one-half hour longer, therefore it was removed. It was found that where formerly at 5.5 centimeters I felt the two points of the esthesiometer as one, now I perceived them as two, and only as one at the esthesiometric distance of 4 centimeters, proving therefore an increase of the sensibility of 1.5 centimeters.

CONCLUSION.

If we once more look over the results of all preceding examinations, we have to note the following:

In cases of hysterical hemianesthesia, a simple irritation, in

the form of a mustard plaster, provided it is applied sufficiently long, occasions *under all circumstances* an augmentation of the sensibility at the place which is excited. This augmentation of the sensibility can occasionally not only bring about the restitution of the lost sensibility, but even can provoke a hyperesthesia, so that the simple touch may be already painful. This restitution of the sensibility sometimes coincides with a diminution of the sensibility on a part of the body situated symmetrically to the part excited. But the results in my experiments could not be obtained constantly. Of the results obtained in my observation with the metals, we can only say that they in general do not possess the constancy as the just mentioned irritation. Of the four metals applied upon a hemianesthetic person (Fensch) copper was the only one which occasioned an augmentation of the sensibilities at the place of application, sometimes with, sometimes without diminution of the sensibility on a part of the body situated symmetrically to it.

In healthy persons I have had to note under the influence of the metals very inconsistent results. Sometimes the metals were able to increase the sensibility at the place applied; sometimes, on the contrary, they decreased it. Sometimes they absolutely did not exercise any action upon the sensibility.

It follows, therefore, that a reliable influence of the metals upon the sensibility of the healthy male cannot be pronounced; on the contrary, I have to denote with a surety, and without any exception, that a simple irritation (sinapism) augments the sensibility at the place of application, and diminishes it at a place situated symmetrically to it. It follows that if metals influence the sensibility of hysterical persons, this influence must be explained in another manner than by the influence of the metals upon the sensibility.

The most important result of my examination is the fact that in healthy persons a simple irritation increases the sensibility of the part excited and decreases it upon the side not excited. There is no doubt that this phenomena appertains to those functions found by Adamkiewicz, and described by him under the name of "Bilateral Functions." When in a category of these functions (secretion of perspiration) it treats of synergistic actions of the centers of organs situated symmetrically, the sensibility of the body represents a bilateral function in which the ganglia of symmetrically-situated organs are antagonistic to one another in their function.

But the circumstance that Anna Serebrenni had found,[1] after the use of cuticular irritations, a small decrease of the sensibility, I would infer that the authoress, as can be learned from her representation, had examined the sensibility of the arm opposite the one where the irritants were applied.

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1 Ueber die Emfluss der Hautreize auf die Sensibil der Haut Dus, Bern, 1876, p. 11.